provided with an iron shoe or cutting ring, and sinks downwards at first in virtue of its own weight, being lengthened at the top as in the previous case, but after a time it generally becomes necessary to force it down by the pressure of screws, assisted by the blows of an instrument resembling a pile-driver. When it cannot be made to sink deeper, another similar cylinder of smaller diameter is introduced into its interior, the same series of operations are again gone through, and so on until the solid ground is reached.

Simple as the last described process may appear, its application is sometimes attended with difficulties of almost incredible magnitude. As an example we may mention two shafts which were sunk through about 400 feet of the kind of ground in question at the Colliery Rheinpreussen, near Ruhrort in Germany. One, begun in 1857, was not finished after more than eighteen years' constant perseverance; while the other, begun in February, 1867, was only completed down to the solid ground in June, 1872.

The new method invented by Herr Poetsch is described by Bergassessor G. Kohler in the *Berg und Hüttenmännische Zeitung*, No. 38, xlii. *Jahrgang*, September 21, 1883. It consists in freezing the water contained in that portion of the running ground which occupies the position of the intended shaft into a solid mass of ice, and then sinking through it by hand without having to pump any water. To this end a preliminary shaft of larger dimensions than the intended shaft is sunk down to the natural level of the water. A number of vertical bore-holes about one metre apart are then put down round about its sides at the bottom, so that they pass through the ground just outside the lining of the intended shaft. Others are put down within the area of the intended shaft, and one is put down in its centre. All of these bores are continued down to the bottom of the running ground. They are made by means of the sand-pump, and are lined with sheet-iron tubes in the usual way. A circular distributing pipe with small copper tubes branching from it is placed at the bottom of the preliminary shaft. One copper tube extends to the bottom of each bore-hole, and each tube is provided with a stopcock. At the surface are several ice-making machines of the Carré type. The liquid intended to circulate through the bore-holes and effect the operation of freezing consists of a solution of the chlorides of magnesium and calcium, whose freezing-point lies between – 35° C. and – 40° C. By means of a small force-pump it is made to circulate at such a rate that it leaves the cooling-trough with a temperature of about – 25° C. It descends into the distributing pipe, passes through the copper tubes to the bottom of the bore-holes, ascends outside the copper tubes to the top of the bore-holes, finds its way into a collecting-tube, reascends to the surface, passes through the cooling-trough, and then commences the downward journey again.

Herr Poetsch estimates that, under ordinary conditions—that is, when the outer ring of bore-holes can be made in the ground outside the lining of the intended shaft—the freezing process will occupy from ten to fourteen days.

When it has been ascertained by means of bore-holes that the wall of ice round about the intended shaft is thick enough, the operation of sinking is commenced. The ice is cut out by hand, and a descending cylinder of masonry or iron is carried down at the same time. The lining prevents the surrounding ice-wall from breaking inwards, and the bottom cannot burst upwards.

Herr Kohler made a personal inspection of this process at the shaft Archibald now being sunk to the lignite beds at Schneidlingen, in Germany. The shaft passes through a bed of running sand four metres thick. Twenty-three bore-holes were employed in two rows near its sides. The freezing process was completed on August 10 last, when the running sand had become a compact mass of such great hardness that no impression could be made on it by the finger-nail, and it was with considerable difficulty that a flake 15 mm. thick could be broken from it.

Sufficient data do not yet exist for estimating the cost of this process as compared with those already known, but we are of opinion that if the operation of freezing can be effected in two or three weeks, or even months, it will compare favourably with them in this respect under almost any circumstances. We believe also that it is capable of application under a variety of circumstances not mentioned in Herr Kohler's article, such as damming back an excessive flow of water in solid ground, driving horizontal drifts or tunnels through mud and sand, and so on. We would therefore recommend the inventor rather to turn his attention in this direction than to think of condensing the intake air of mines by the application of cold, with the view of dispensing with ventilating furnaces and enabling winding operations to be carried on in upcast as well as in downcast shafts. The former field, if we mistake not, will be a large one; the latter, we can safely promise him, will be a very small one.

WILLIAM GALLOWAY

NORDENSKJÖLD'S GREENLAND EXPEDITION

IN a series of letters to Mr. Oscar Dickson, Baron Nordenskjöld has given a detailed report of the leading incidents and results of his recent expedition, though it will still be some time ere we can learn what are the full gains to science. The leading novelty of the expedition was, of course, the journey into the interior of Greenland. We have already given some account of Dr. Nathorst's visit to the Cape York region, and in the present article will confine ourselves mainly to Nordenskjöld's own journey up the interior. We reproduce a sketch map of this journey, which Mr. Dickson has been good enough to send us. After mentioning his attempt to approach the south-east coast of Greenland, Nordenskjöld says:—

The ice much resembled the big rough blocks which are encountered north of Spitzbergen. The surface here carries a cold current which sets the ice on shore. The polar current is however not very voluminous; thus in a depth of a couple of fathoms Herr Hamberg discovered, through careful survey, a decided warm current from the south. The depth of the sea was not great, and the bottom consisted of large blocks which tore the trawling net and prevented dredging.

After landing Dr. Nathorst and his party at Waigatz Sound, Nordenskjöld went back to Egedesminde, which he reached on June 29. He then proceeds:—

The following day I left for Auleitsivik Fjord, from which my expedition was to start. This fjord is about 130 kilometres long, and very narrow in the middle, not unlike a river, which widens at the bottom into a bay, Tessiusarsoak, into which an arm of the inland ice shoots. This remarkable formation, and the great tides which favour this part of Greenland, make the navigation here very difficult. As in most of the Greenland fjords the sea is deep and free from reefs. A remarkable feature, too, is that icebergs coming athwart the narrows in the fjord cause the water in the bay suddenly to rise some ten to twenty feet. The Esquimaux relate that some years ago a boat with men, women, and dogs was drawn under here by the whirl currents. They are, in consequence, afraid of rowing in the narrows.

In 1870 I had paid a visit to this fjord and examined these difficulties, which I believed would have increased rather than otherwise during the last thirteen years, through those changes which so often occur in the position and size of the moving glaciers which shoot down from the inland ice. On inquiry I was told that no European had been in the fjord since 1870. Still my knowledge of the feasibility of getting at least some 50 kilometres inland from this spot decided me to select it as my *point d'appui*.

On July 1 the *Sophia* anchored in the bay just north of the inland ice. We found here a splendid harbour with clay bottom, some seven fathoms deep, surrounded by gneiss rocks from 600 to 1000 feet in height, the sides of which are in some places covered with low but close shrubs, or clothed with some species of willow, mosses, and lichen, which, when we arrived, were ornamented with a quantity of magnificent blossoms. From one of the slopes a torrent descended, the temperature of which was 12°·3 C. The weather was fine, the sky cloudless, and the air very dry. July 1 to 3 were employed in making preparations for the ice journey, while the naturalists made excursions to various places in order to collect objects relating to the conditions of the country. On the night of the 3rd everything was ready for a start, and after some difficulty in reaching the spot where the baggage was we were fairly off. The spot from which we set out on the journey was only five kilometres from the actual shore, and situated below a little lake into which a number of glacier rivers fell. We proceeded up the river in a Berton boat purchased in England. On the night of the 4th we camped for the first time on the ice. The expedition consisted of nine men besides myself. After a great deal of hard work in getting the sledges over the ice, which was here very rough, we found on the morning of the 5th that it was impossible to proceed eastwards, but were compelled to return to the border of the ice and then continue to the north or north-east until finding smoother ice. This first part of the ice was furrowed by deep crevasses and ravines, causing us much trouble. We covered, however, a good distance that day, and pitched our tent near a land ridge in the ice 240 m. above the sea.[1] On July 6 I sent the Lapp Lars forward to reconnoitre, and he reported that it was still impossible to proceed eastwards, but if we marched for a day or so to the north we would find the country accessible to the east. As I feared, however, the impossibility of dragging the sledges with the weight on them over the rough ice, I selected provisions, &c., for forty-five days and left the rest in a depot in the ice. We now resumed the march. It was very interesting to witness the great ease with which the Lapps proceeded among the ice ravines, how easily they traced a road discovered, and with what precision they selected the least difficult track.

The Lapp Lars carried, instead of an alpenstock, a wooden club, with which he had slain more than 25 brown bears, full of marks from their teeth, and his eyes sparkled at the thought of encountering a white one. On the night of the 6th we held our third camp on the ice, and now several officers and men from the *Sophia*, who had accompanied us thus far, left us. Besides the most advantageous requisites for such a journey, we had with us a cooking apparatus for petroleum, and here I beg to say that I found this kind of oil far more suitable than train or vegetable oils, which I had used on my former expeditions, and I recommend the same most warmly to Arctic explorers. Of scientific instruments I may mention compasses, two chronometers, a circle by Pistor and Martin, a small sextant, in case of the former being damaged, a mercury horizon, three aneroid barometers, thermometers, magnets, for the study of the clay deposit in the snow, a topographical board, a photographic apparatus, blowpipes, flasks, nautical tables, &c. The sledges "kalkar," six in number, were of the same kind as those on which Swedish peasant women bring their wares to market; the harness was made so strong that it would hold a man in case of his falling into a crevasse. In addition to these things we had a manilla rope specially spun for the expedition at the Alpine purveyor's in Paris. The food supplied per day may perhaps interest explorers. It was—breakfast: coffee, bread, butter, and cheese (no meat or bacon); dinner: 42 cubic c.m. Swedish corn brandy (*brännvin*), bread, ham or corned beef, with sardines; supper: preserved meat, Swedish or Australian. Sometimes preserved soup was served with dried vegetables. Five men were teetotalers, but there was no need of supplying them with extra rations. For cooking, 0·7 litres of spirits were consumed per day. Our whole baggage weighed a ton, a weight which might easily have been drawn across a smooth snow or ice field, but which was very difficult of transporting over the rough and cut-up surface we had to traverse. Our daily march, between July 7 and 9, was, therefore, not great, viz. 5 kilometres a day. In addition to the crevasses and ravines, we encountered innumerable rivers, swift, and with steep banks which were difficult of crossing, which was generally accomplished by laying three alpenstocks across them. If I had not selected these of the toughest wood obtainable, we should often have had to make detours of many kilometres.

On these days we found on several occasions large bones of reindeer on the snow, and it was but a natural and pardonable conclusion to arrive at, that they were those of animals who had fallen in their wandering over the "Sahara of the Arctic regions." But that good signs are not always true ones we soon discovered.

During the entire journey we had great difficulty in finding suitable camping places. Thus either the ice was so rough that there was not a square large enough for our tent, or else the surface was so covered with cavities, which I will fully describe later on, that it was necessary to pitch it over some hundred smaller, and a dozen larger, round hollows, one to three feet deep, filled with water, or else to raise it on a snow-drift so loose and impregnated with water that one's feet became wet even in the tent. An exception to this was the place where we camped on July 9, viz. camping-place No. 6. We encountered here a small ice-plain, surrounded by little rivers, and almost free from cavities, some thirty metres square. All the rivers flowed into a small lake near us, the water from which rushed with a loud roar through a short but strong current into an enormous abyss in the ice plateau. The river rushed close to our tent, through a deep hollow, the sides of which were formed of magnificent perpendicular banks of ice. I had the spot photographed, but neither picture nor description can give the faintest idea of the impressive scene, viz. a perfectly hewn aqueduct, as if cut by human hand in the finest marble, without flaw or blemish. Even the Lapps and the sailors stood on the bank lost in admiration.

At first we had followed the plan of bringing the baggage forward in two relays, but, finding this very fatiguing, I decided to bring all with us at once. I found this to answer better. On July 10 we covered thus nine and a half, on the 11th ten, and on the 12th eleven, kilometres. The road was now much better than before, although stiff enough. An exception to this was, however, formed by the part we traversed on the 11th, when we proceeded alongside a big river, the southern bank of which formed a comparatively smooth ice plain, or rather ice road, with valleys, hills, cavities, or crevasses, some five to ten kilometres in width, and five kilometres in length. This plain was in several places beautifully coloured with "red" snow, especially along the banks of the river. It was the only spot on the whole inland ice where we found "red" snow or ice in any quantity. Even yellow-brown ice was seen in some places, but, on the other hand, ice coloured grayish-brown or grayish-green, partly by kryokonite, and partly by organisms, was so common that they generally gave colour to the ice landscape.

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[1] The altitudes were ascertained by comparing three aneroid barometers, while observation was simultaneously made at Egedesminde with a splendid sea barometer I had left there for that purpose. As the figures have, however, not yet been verified, they may be slightly altered. They seem on the whole too low.

Even on July 12—between camps Nos. 7 and 8—we found blades of grass, leaves of the dwarf-birch, willows, crackberry, and pyrola, with those of other Greenland flora, on the snow. At first we believed they had been carried hither from the interior, but that this was not the case was demonstrated by the circumstance that none was found east of camp No. 9. The only animals we discovered on the ice were, besides the few birds seen on our return journey, a small worm which lives on the various ice algæ, and thus really belongs to the fauna of the inland ice, and two storm-driven birds from the shore. I had particularly requested each man to be on the look-out for stones on the ice, but after a journey of about half a kilometre from the ice border no stone was found on the surface, not even one as large as a pin's point. But the quantity of clay dust ("kryokonite") deposited on the ice was very great; I believe several hundred tons per square kilometre.

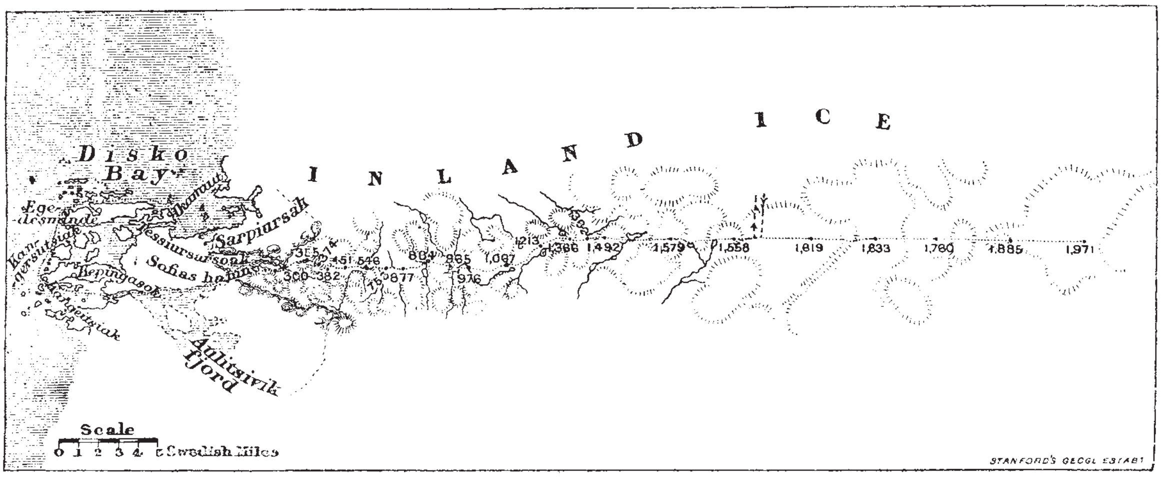
We now ascended very rapidly, as will be seen from the subjoined statement of our camps:—

3rd camp, 300 metres above the sea.
4th ,, 355 ,, ,,
5th ,, 374 ,, ,,
6th ,, 382 ,, ,,
7th ,, 451 ,, ,,
8th ,, 546 ,, ,,
9th ,, 753 ,, ,,

The 9th camp lay on the west side of an ice ridge close by a small, shallow lake, the water from which gathered as usual into a big river, which disappeared in an abyss with azure-coloured sides. From this spot we had a fine view of the country to the west, and saw even the sea shining forth between the lofty peaks on the coast; but when we reached east of this ice ridge the country was seen no more, and the horizon was formed of ice only.

Through an optical illusion, dependent on the mirage of the ice horizon, it appeared to us as if were proceeding on the bottom of a shallow, saucer-shaped cavity. It was thus impossible to decide whether we walked up or down hill, and this formed a constant source of discussion between us, which could only be decided by the heaviness of the sledges in the harness. The Lapps, who seemed to consider it their sole business that we should not be lost on the ice, came to me in great anxiety and stated that they had no more landmarks, and would not be responsible for our return. I satisfied them, however, with the assurance that I would find the way back by means of a compass and solar measurements. In spite of this the Lapps easily traced our route and our old camps with an accuracy quite marvellous.

During our outward journey I determined the site of each camp astronomically, and thus the distances which, when the determinations have been calculated, will be given on the map to be drawn of the journey will be absolutely correct. But the distances covered by the Lapps have been made according to their own judgment. The kilometres we covered every day, including the numerous detours, were ascertained by two pedometers.



The heights are given provisionally in metres. Swedish mile = 6·64 English miles.

Up to the 9th camp we were favoured by the finest weather, generally with a slight south-east wind, cloudless sky, and a temperature in the shade, three feet above the ice, of 2° to 8° C., and in the sun of even 20° C. The centre of the sun's disk sank in this spot for the first time below the horizon on July 15, and the upper rim, if allowance is made for refraction, on July 21. After the middle of July, when at an elevation of 4000 to 7000 feet, the nights became very cold, the thermometer sinking to 15° and 18° below freezing-point of Celsius.

The constant sunshine by day and night, reflected from every object around, soon began to affect our eyes, more so, perhaps, because we had neglected to adopt snow-spectacles at the outset of our journey, and snow-blindness became manifest, with its attendant cutting pains. Fortunately Dr. Berlin soon arrested this malady, which has brought so many journeys in the Arctic regions to a close, by distributing snow-spectacles and by inoculating a solution of zinc vitriol in the blood-stained eyes. Another malady—if not so dangerous, at all events quite as painful—was caused by the sunshine in the dry, transparent, and thin air on the skin of the face. It produced a vivid redness and a perspiration with large burning blisters, which, shrivelling up, caused the skin of the nose, ears, and cheeks to fall off in large patches. This was repeated several times, and the pain increased by the effect of the cold morning air on the newly-formed skin. Any similar effect the sun has not in the tropics. With the exception of these complaints none of us suffered any illness.

On July 13 we covered thirteen, on the 14th ten, and the 15th fourteen, kilometres (9th to 12th camps). At first the road gradually rose, and we then came to a plain which I in error believed was the crest of the inland ice. The aneroids, however, showed that we were still ascending: thus the 9th camp lies 753, the 10th 877, the 11th 884, and the 12th 965 metres above the sea. Our road was still crossed by swift and strong rivers, but the ice became more smooth, while the kryokonite cavities became more and more troublesome. This was made more unpleasant by rain which began to fall on the afternoon of July 13, with a heavy wind from south-east. It continued all the night, and the next morning turned into a snowstorm. We all got very wet, but consoled ourselves with the thought that the storm coming from south-east argued well for an ice-free interior. When it cleared a little we strained our eyes to trace any mountains which would break the ice horizon around us, which everywhere was as level as that of the sea. The desire soon "to be *there*" was as fervent as that of the searchers of the Eldorado of yore, and the sailors and the Lapps had no shadow of doubt as to the existence of an ice-free interior. And at noon, before reaching camp No. 12, everybody fancied he could distinguish mountains far away to the east. They appeared to remain perfectly stationary as the clouds drifted past them, a sure sign, we thought, of its not being a mass of clouds. They were scanned with telescopes, drawn, discussed, and at last saluted with a ringing cheer. But we soon came to the conclusion that they were unfortunately no mountains, but merely the dark reflection of some lakes further to the east in the ice desert.

A. E. NORDENSKJÖLD

(*To be continued.*)

THE RE-ENTOMBMENT OF WILLIAM HARVEY

FOR two hundred and twenty-six years the mortal remains of the immortal discoverer of the circulation of the blood rested, unburied, in a vault of a little church in the parish of Hempstead, about seven miles from Saffron Walden, in Essex.

Harvey died on the 3rd of June, in the year 1657, being then in his eightieth year, but the precise place of his death is not known. He fell, full of days and honours, and retained his faculties so completely to the last day of his life that he directed his apothecary, Samboke, what to do in the way of treatment. He beckoned to Samboke to take blood from under the tongue as the speech was failing,—a line of treatment which would have little favour in these days,—and as the sun of June 3 went down he went down also. His death, no doubt, took place in London, and probably near to Smithfield.

On June 26, twenty-three days after the death, the body of William Harvey was laid in the vault at Hempstead. In the interval a cast had been taken from the face for a rough and ready sculptor to work from, and the body, after a custom of the time, rolled first, in all probability, in a cere cloth, had been inclosed in a leaden chest. It was then conveyed to Hempstead, a distance of about fifty miles, in those days a journey of no slight importance. The body was followed by many of the Fellows of the College of Physicians out of town, and it may be that some of them went as far as Hempstead. Certainly one scholar, though he was not a Fellow, namely Aubrey, the historian, was present when the body was put into the vault. "I was at his funeral, and helpt to carry him into the vault." These are Aubrey's words. The vault referred to had been built by Eliab, the merchant brother of the anatomist, and over it was erected a chapel connected with the church at the north-eastern corner. The vault was afterwards filled with the bodies of members of the Harvey family, some few "lapt in lead," like their great relative, others laid in coffins.

For nearly two centuries little seems to have been recalled of the remains of the anatomist. They lay with their kindred in the village sepulchre without reference being made to them. In 1847 Dr. Richardson, F.R.S., then assisting Mr. Thomas Browne, a surgeon in Saffron Walden, was told one day by a cottager that the great Dr. Harvey was buried in Hempstead Church, and next day discovered that it was really Harvey the anatomist and physiologist, and that the body, "lapt in lead" as Aubrey described, lay there probably as it had originally been placed.

At that time the foot of the leaden chest lay under the open window of the vault. There was then no opening in the lead, but the upper surface towards the middle of the body was beginning to show signs of sinking in. There was much dust and several stones on the chest, which were removed. The remains were reported upon after this by Dr. Tyler Smith, who had visited the place, to the Royal College of Physicians, and in 1859 the College deputed the late Dr. Alexander Stewart and Dr. Quain to visit and report. They made their report, and some changes were carried out in the vault; but the window, although protected by the addition of iron bars, was left open, and, under the influence of air and damp, the lead began to give way.

From time to time Dr. Richardson visited the place and reported on the changes which were in progress. In the lower part of the lid of the leaden chest the sinking became so increased that a kind of oblong basin was formed, in which rain water, beating in from the window, accumulated. Then an opening, taking the shape and size of one of the sound openings in a violoncello, was formed, and water was admitted into the shell itself. Twice it seemed filled with thick pitchy-looking fluid, and although the opening was temporarily filled up with solder, the repair did not last very long.

In 1878 Dr. Richardson made another visit to Hempstead, and on November 30 of that year published in the *Lancet* a full report on the condition of the remains, together with six illustrations. The report created considerable attention, and led the way to the alteration that has been recently effected. In January, 1881, the beautiful tower of the old church at Hempstead suddenly fell, dragging a portion of the church with it. It was found that the Harvey vault and chapel were not injured, but that the leaden shell in which Harvey was laid was again filled with water, and that the preservation of the case could not be much longer insured. In February, 1882, the Royal College of Physicians, formed a committee to undertake the duty of placing the remains in a position in which they would be permanently retained. The result was that the College obtained permission of the representatives of the Harvey family to remove the remains from the vault and to place them in a solid marble sarcophagus in the Harvey chapel above. Such is a succinct history of the proceedings previous to the removal and re-entombment on October 18 of this year.

The ceremony of the 18th was extremely simple. As was befitting, a number of the Fellows of the College—eight in all—bore the remains from the vault along the northern side of the church to the western entrance, and so through the aisle to the entrance of the Harvey chapel, on the left of the chancel. The vicar of Hempstead, the Rev. R. H. Eustace, and the curate, the Rev. J. Escreet, led the procession; then came the bearers with their charge on a bier; after them, four of the representatives of the Harvey family; and, next in order, the President, all the office-bearers, and the Fellows of the Royal College of Physicians who had come to take part in the ceremonial.

After a short service the leaden case was placed in the sarcophagus. On the breastplate of the case the original inscription—

Doctor
William . Harvey
Decesed. The . 3.
Of Jvne 1657.
Aged 79 years

was still quite perfect, as was also a rough metal cast of a face with a small imperial from the lower lip to the chin. After the remains had been laid in the marble, the President of the College, Sir William Jenner, placed on them a leaden case containing the College edition of the complete works of Harvey. The volume was the Latin edition of 1766, edited for the College by Mark Akenside, including in the first pages a life